THE CHANGING MOTH AND BUTTERFLY FAUNA OF BRITAIN DURING THE TWENTIETH CENTURY

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Abstract

This paper attempts to identify those species of Lepidoptera that have colonised Britain and those that have may have become extinct during the twentieth century. Reasons for these changes are discussed and changes in the Lepidoptera fauna in relation to native and non-native plants, along with regional changes, are briefly examined.

Introduction

Over time it would be expected that the number of species recorded from any given area would change either through the processes of colonisation and extinction, or as new species are discovered. This is the case with Britain. By comparing the number of species covered in books on the British Lepidoptera (moths and butterflies) fauna over the last 100 years or so (see Table 1) it is apparent that over 540 species have been added to the British list. To put this another way, on average about five species have been added each year. This total includes many species that have been added through taxonomic changes or occurred on one or just a few occasions, or species that have not become established. This review, however, describes the changing fauna of Britain in the twentieth century by considering adventive and immigrant species that have become established in the wild (the colonisers) and those species that have become extinct or for which there is no recent record.

Source	No. of Species
Meyrick (1895)	2061
Meyrick (1928)	2143
Heslop (1964)	2404
Bradley & Fletcher (1979)	2501
Bradley (2000)	2604

Table 1: Number of species on the British list by publication Note: Some of these publications include the few species found in Ireland that are not found in Britain.

Methods

In this review, species have been divided into broad classes according to information (or lack of) on previous history and nature of arrival in Britain. There is a degree of guesswork about the species considered and it may be argued that some could be attributed to different categories and others added.

The colonisers

This category includes species that have become established as breeding species in the wild in this country either through the assistance of man (the adventives), for

example through accidental introduction, or through immigration. It must be borne in mind when considering some of the tables, that some species could have become established in the country before they were discovered.

Transitory residents

Species have also been included in this review if they were established for at least a ten year period and subsequently died out (the exception to this being any species since 1990 as not enough time has elapsed).

Overlooked species, additions through taxonomic considerations, species with no confirmed records and species that have not become established

Species that were (or probably were) overlooked residents in this country are not covered by this review. The Southern Chestnut *Agrochola haematidea* (see Haggett & Smith, 1993) and *Bactra lacteana* (see Heckford, 1998) are examples of species that could fall into this category. Another group of additions not included are those species that have been added through taxonomic considerations. Examples include *Sorhagenia janiszewskae* (see Bradley, 1963) and Lesser Common Rustic *Mesapamea didyma* (see Jordan, 1986). There are also, perhaps rather surprisingly, a few species on the British list for which there is no confirmed British record, e.g. the Ash Shoulder Knot *Scotochrosta pulla* (see Bradley, 2000). Two further categories of species are the adventive and immigrant moths that have not become established, e.g. *Eccopsia effractella* (see Agassiz, 1996a) and *Cydia amplana* (see Heckford, 1993) respectively are examples of these. Neither of these groups are considered here.

Species considered extinct (or no recent record)

This category covers those species thought to be extinct or for which there is no recent record (and may well be extinct) in the period from 1900 onwards.

Changes in the Lepidoptera fauna from 1900 to 1999

The colonisers

Of the approximately 540 additions to the British list, 89 species are considered to have become established colonisers through immigration or established adventives between 1900 and 1999, although three of these species have subsequently become extinct (see Table 2 and Appendix 1).

A number of species could be added to this list of 89. For example, it is uncertain when the Vine's Rustic *Hoplodrina ambigua* became established. This moth is not included as it was first recorded in 1879 and was later found along the south coast. It was long regarded as an immigrant, at most temporarily established. After about 1940 it spread rapidly inland (Bretherton, Goater & Lorimer, 1983). The Waved Black *Parascotia fuliginaria* is similarly not included. This moth was considered a great rarity usually found near docks or in cellars, although it is now more widely recorded. It was not until 1931 that this moth's true habitat and principal foodplant were discovered (Bretherton, Goater & Lorimer, *loc. cit.*).

Date class	Total no. of new colonisers	Thirty year combined total
1900-1909	3	
1910-1919	2	
1920-1929	6	11
1930-1939	10	18
1940-1949	11	27
1950-1959	14	35
1960-1969	7	32
1970-1979	14 (-1)	35 (-1)
1980-1989	8 (-2)	29 (-3)
1990-1999	14	36 (-3)
Total	89 (-3)	

Table 2: Summary of Lepidoptera colonisers from 1900 to 1999. Figures in parentheses represent the number of colonising species that have subsequently become extinct.

Extinctions (or no recent record)

From 1900 onwards, the present review identifies 62 species of Lepidoptera have either become extinct or for which there is no recent record and may well be extinct (see Table 3 and Appendix 2). An additional four species could be added to this total. These four (*Stenoptinea cyaneimarmorella*; *Scrobipalpula diffluella*; *Gnorimoschema streliciella*; *Scythris fuscoaenea*) are little known in this country, but were probably resident and may now be extinct. Fewer species are included as extinct in recent years as it is very difficult to determine whether or not a species has been lost in such a comparatively short time. For example, the Orange Upperwing *Jodia croceago*, which is not included in the tables, has not been seen in recent years, despite considerable survey effort. The last confirmed sighting was in 1994 (A. Spalding, pers. comm.). It is still hoped that this species will be refound in this country. This total compares with that of Leverton (2001) who suggests that about 65 species of moths are thought to have become extinct since reliable records began around 150 years ago.

It is possible that some of the species listed may be overlooked and may yet be refound in this country. This is illustrated by the rediscovery of the micro-moth *Trifurcula beirnei* which had not been seen since 1935 when it was recorded at Southampton (Emmet, 1986). In 2000, a single adult was found at Southsea (J.R. Langmaid, pers. comm.).

A few species have not been included as their status since 1900 is uncertain, e.g. *Stigmella desperatella* (Frey). Vacated mines, possibly of this species, were found by S.C.S. Brown at Dover in the 1960s (reported to M. Chalmers-Hunt in a letter dated 17th January 1971), but recent searches of the area have failed to find the species (D. O'Keeffe, pers. comm.). The status of *Celypha doubledayana* and *Scythris cicadella* since 1900 are similarly open to question as no confirmed records could be researched during the period since that date.

Date class	Total no. of species considered to be extinct or possibly extinct	Thirty year combined total
1900-1909	8	
1910-1919	7	
1920-1929	6 (+2)	21 (+2)
1930-1939	9 (+1)	22 (+3)
1940-1949	(1)	15 (+4)
1950-1959	6	15 (+2)
1960-1969	13	19 (+1)
1970-1979	9	28
1980-1989	2	24
1990-1999	2	13
Total	62 (+4)	

Table 3: Summary of extinctions or species not recorded from 1900 to 1999. Figures in parentheses represent the number of species that are little known in this country, but may now be extinct.

It is apparent from Tables 2 and 3 that there are a number of peaks (when data are treated on a decade by decade basis) in both numbers of colonisers and possible extinctions, though these peaks do not seem to coincide. Interestingly there is almost an inverse correlation, i.e. when there are more apparent extinctions there are less species colonizing and vice versa.

Regional changes

When examining the broad distribution of change of the colonisers and extinctions in this review, a pattern of change becomes apparent. In both cases south-eastern England and southern England have by far the highest totals of gains and apparent losses (Tables 4 and 5). This suggests that it is these areas were there is greatest turnover in the fauna. Part of this change is undoubtedly due to proximity to the continent (i.e. it is comparatively easy for a species to establish itself from abroad), but the figures imply that changes in these regions dominate overall change in the country, be it through the effects of climate or/and habitat loss or change.

This change is likely to be even greater as it has been beyond the scope of this review to examine the colonisers and extinctions within the faunas of individual regions, but these regional distribution changes are undoubtedly happening. This is probably most easily demonstrated at a county level, for example McCormick (2001) lists a number of species that have not been seen in Devon for many years, along with many recent additions to the county. Further examples are given in Asher *et al* (2001), who discuss distribution changes and trends in butterfly species, and by Agassiz (1996b) who discusses invading Lepidoptera, giving examples of the geographical patterns of spread in the British Isles of various species.

Region	Total no. of species
South-east (includes Kent, Surrey, Sussex, South Essex and Middlesex)	53
South (includes Hampshire, Isle of Wight, Dorset and Berkshire)	17
South-west (includes Cornwall and Devon)	7
East Anglia (includes Norfolk, Suffolk and North Essex)	4
East Midlands (includes Huntingdonshire and Cambridgeshire)	3
West Midlands (includes Derbyshire, Cheshire)	2
North-west (Cumbria)	1
North-east (Yorkshire)	1
Mid Scotland (Perthshire)	1

Table 4: Colonising Lepidoptera on a regional basis (1900 to 1999)

Region	Total no. of species
South-east (includes Sussex, Kent, Surrey and South Essex)	23 (+1)
South (includes Somerset, Dorset, Hampshire, Isle of Wight, Wiltshire, Buckinghamshire, Berkshire and Oxfordshire)	12 (+1)
East Anglia (includes Norfolk and Suffolk)	9 (+1)
East Midlands (includes Huntingdonshire, Cambridgeshire, Northamptonshire, Lincolnshire and Nottinghamshire)	8
West Midlands (includes Gloucestershire, Herefordshire and Worcestershire, Staffordshire and Cheshire)	7
North-east Scotland (includes Moray)	2 (+1)
South-west (Devon)	1
North-west (Cumbria)	1
South Wales (Glamorgan)	1
North Wales (Caernarvonshire)	1

Table 5: Summary of extinctions or species not recorded from 1900 to 1999 on a regional basis.

Reasons for change

The colonisers

Discussing additions to the British list of Lepidoptera has long been a popular topic and one that has been covered by a number of authors over the years, e.g. Ford (1949), Ellerton (1970) and Agassiz (1992) discuss additions to the British list of microlepidoptera (smaller moths), and de Worms (1951 &1963) and Mere (1961) discuss macrolepidoptera (larger moths) additions, the latter considering England only. Leverton (2001) also lists the presumed gains (and losses) of resident British microlepidoptera, giving 58 apparent gains (and 30 apparent extinctions).

Mere (1961) suggested many of the "new" species were associated with introduced foodplants. Table 6 shows that this is a trend that has clearly continued, many of the species that have become established over the last century are associated with non-native plants. Moreover, there is also a hint from the data collated that this trend may be on the increase.

Date class	Polyphagous	Tree/shrubs		Low-growing plants and grasses		Other, including ferns, leaf litter etc.
		Native	Non-native	Native	Non-native	
1900-1909	1	1				1
1910-1919			1			1
1920-1929		2	3	1		
1930-1939	1	1	3	5		
1940-1949		2	4	1	2	2
1950-1959	1		1	4	1	
1960-1969		2	4	1		
1970-1979		3	5	5		1
1980-1989		1	5	2		
1990-1999		1	6	6	1	
Total	**3**	**13**	**32**	**25**	**4**	**5**

Table 6: Number of colonising Lepidoptera by foodplant type (1900 to 1999).

It is interesting to note that conifers and evergreens were popular in Victorian times but went out of fashion during the first half of the 20th century. These came back into vogue again particularly during the 1960s with the development of garden centres. With the development of the single market in the European Union (EU) countries, an extensive trade in plants between Britain and other EU countries has developed, with the Netherlands, Spain, Italy, Denmark, France and Germany being significant sources of nursery stock. British nurseries also obtain plants from outside Europe (A. Halstead pers. comm.). Twelve species that have become established since 1959 are associated with conifers (including cypresses and junipers).

Although 36 species have probably colonised following the introduction of a non-native host plant (either with the foodplant or because the foodplant has been widely planted, and this could be aided by planting of the foodplant on the continent enabling colonisation through immigration), over 40 species have arrived that feed on long established native foodplants. One of the most likely explanations for this is climate change. As early as 1961, Mere speculated that the most likely cause of colonisations around that time was an increase in spring, summer and autumn temperatures.

Climate change has been considered as influencing changes in Lepidoptera distribution by a number of authors. de Worms (1963) discusses climate change, noting that there had been an apparent northward movement of certain species which had only then recently been recorded in the British Isles on the continent and that this had been correlated with a small but significant warming-up of the average temperature in Northern Europe over the previous 30 years. Burton (1998 & 2001) also discusses apparent responses of European insects to climate change and has

evidence of 245 species of macrolepidoptera and Pyralidae whose breeding distributions have altered. Some of these species have spread irrespective of habitat loss. Burton (2001) concludes that "alterations in geographical ranges of various insects do not in themselves prove without doubt that such distributional changes are due to the effects of climate change, but their broad correlation with known climatic oscillations over the past two centuries....is highly suggestive that climate has been a primary influence in many cases".

Parmesan *et al* (1999) analysed distributional changes over the past century of non-migratory species of butterfly whose northern boundaries were in northern Europe and whose southern boundaries were in southern Europe or northern Africa and suggested that many butterfly species in the northern hemisphere are shifting northwards in response to a common environmental change and that this is increased temperature. They point out that Europe has warmed by about 0.8°C during the last century and that predicted increases for this century are considerably higher and consequently could be a major influence in shifting species' distributions. Fifteen species of resident British butterflies have shown substantial expansions in range recently. Fox *et al* (2001) suggest that climate appears to be the main factor causing butterflies to spread and note that average spring and summer temperatures in Britain have increased by 1.5 and 1°C respectively in the past 25 years. These climatic influences are likely to have a similar effect on many moth distributions.

Habitat change is also likely to have provided opportunities for some colonising species. de Worms (1963) suggested that the White-banded Carpet *Spargania luctuata* had probably been able to gain a foothold in this country due to the growth of its foodplant wherever large tracts of woodland had been cut-down in southern England. The species is still resident and is found particularly in conifer plantations. Habitat change may also explain why the Sussex Emerald *Thalera fimbrialis* continues to maintain a foothold in Britain. The building of the nuclear power stations on Dungeness has altered the shingle habitat and provided suitable conditions for this species, conditions that do not appear to be present elsewhere in the country.

Extinctions (or no recent record)

A wide range of causes has been suggested as resulting in the extinction (or possible extinction) of individual species. These broadly include development, drainage, woodland clearance, coniferisation, agricultural change and intensification, management changes or a lack of management, fire, parasite load (combined with another influence), habitat fragmentation and climate change. Fox (2001) summarised the changing fortunes for butterflies, and to a lesser extent moths, in recent decades and identified four main causes of these changes. These are habitat loss; management changes; fragmentation and isolation; and climate.

Habitat loss through the intensification of agriculture, large-scale commercial forestry using non-native trees and urban development has resulted in the wholesale loss of semi-natural habitats and their associated faunas. Many habitats are now reduced to isolated remnants. For example, as long ago as 1951, large scale afforestation had been recognised as the greatest danger to Breck district species (Bretherton, 1951). Bretherton also stated that conifer planting "is of course a

menace to local species in other places too", citing two species, the Clifden Nonpareil *Catocala fraxini* and the Lunar Double Stripe *Minucia lunaris*, both of which subsequently died out (although it is uncertain whether these species would have survived even if the conifers had not been planted in these areas).

Many moths and butterflies have specific microclimate requirements. Changes in management can disrupt these conditions with a resultant loss of suitable habitat for individual species. This loss of habitat, either through destruction or change in management leads to fragmentation and isolation. Small isolated populations of individual species are more likely to become extinct as a result of chance events, e.g. fire, disease, unfavourable weather etc. Further to this, the chance of recolonisation in a fragmented landscape is greatly reduced which in turn could be compounded by climate change. Fox (*loc. cit.*) suggests that most of the evidence for the effects of climate change is "circumstantial, relying on comparison of periods of large-scale distribution change with the concurrent climatic characteristics" and also that the relationships between climate and Lepidoptera are complex and remain unclear.

Table 7 gives extinctions by foodplant type. Unlike recently colonised species, most extinct species are associated with native plants. Many of these plants are widespread, though some have a localised distribution. This association is, perhaps, what would be expected given the habitat loss, and fragmentation and isolation, and management changes suffered in the British countryside.

Date class	Polyphagous	Tree/shrubs		Low-growing plants and grasses		Other, including ferns, leaf litter etc.
		Native	Non-native	Native	Non-native	
1900-1909	1	3		4		
1910-1919		3		4		
1920-1929		2	(1)	3 (+1)		1
1930-1939		4		5		1
1940-1949						1
1950-1959		4		2		
1960-1969		4		8		1
1970-1979		2		7		
1980-1989				2		
1990-1999		1		1		
Total	**1**	**23**	**(1)**	**36**		**4**

Table 7: Number of extinctions (or species with no recent record) by foodplant type (1900 to 1999).

Finally, Fox (*loc. cit.*) rightly remarks that the effects of collecting, atmospheric pollution and the use of insecticides are likely to be insignificant in the vast majority of cases. However, it is interesting to note that the total weight of pesticides sold for use in gardens grew by 70% between 1992 and 1997 and herbicides are now used

more intensively in gardens than in arable crops or in orchards, although insecticide use does appear to be decreasing (Ansell, Baker & Harris, 2001). It is not known what the effect of this is, if any, on Lepidoptera populations at the local and at a wider level.

Conclusions

Change to the Lepidoptera fauna of this country has been a source of fascination for many years and there have been a number of recurring themes.

For those species that have become established, the most regularly suggested factors are climate change and association with non-native plants. There is little doubt that the climate is changing and that insect populations and distributions will change in relation to these. Also, it is beyond question that gardening, tidying up of marginal habitats and amenity planting has increased in the latter half of the twentieth century and that this has created substantial areas of habitat for many species associated with non-native plants. Indeed, within urban conurbations there are areas where some plant species are now so widely planted that these could be described as either large areas of suitable habitat or fragmented habitat patches (such as parks, supermarket car parks etc.) with corridors (suburban gardens) for some of these species to utilise.

Some species have established themselves naturally from the continent, and hence must have good powers of dispersal, enabling them to reach other suitable breeding situations in this country. Other species may not be so good at dispersal within their natural distribution, but have been introduced to a niche that was not previously occupied and hence have spread rapidly to occupy this. Some of these may eventually be restricted by climate requirements.

Additions to the British fauna will continue. Some species are becoming more regularly recorded than formerly, for example the Tree-lichen Beauty *Cryphia algae* (which was probably only recorded on three occasions during the 19th century then not seen until 1991, Skinner (1998) reporting 22 others to 1998). Others such as the Humming-bird Hawk-moth *Macroglossum stellatarum* have shown signs of surviving recent British winters. If climate change accelerates and the movement of non-native plants continues in its current fashion then the rate of colonisation of species to this country is very likely to increase.

Whilst these colonisers may be seen as enriching our fauna, it is more worrying that a substantial number of our native species, part of our natural heritage, associated with native foodplants and native habitats, are under threat or have become extinct during the last century. The specific reasons for these extinctions are often difficult to identify. Frequently mentioned culprits are development, agricultural change and intensification, woodland clearance and afforestation, management change (including inappropriate "conservation" management) or lack of management, habitat fragmentation and climate change or a combination of these. These threats seem likely to continue and, as our countryside evolves and changes, further extinctions it seems are sadly inevitable. It is difficult to predict which species are most at risk. However, there must be concern over severely localized species, for example the Reddish Buff *Acosmetia caliginosa*, species that appear to have declined

dramatically in recent years, for example Pale Shining Brown *Polia bombycina* and Bordered Gothic *Heliophobus reticulata*, and species susceptible to climate change, for example mountain top species. Other species are known to have extreme population and distribution fluctuations over a number of years, e.g. the Dotted Rustic *Rhyacia simulans* and, whilst it is assumed that these species will come back as before (though this cannot be guaranteed), the general trend for many of these is unknown.

It is apparent that all these influences are having most effect on the fauna of the southern half of England, particularly south-east and southern England, where change has been most rapid and dramatic. However, change is clearly happening throughout the country.

Paradoxically some of the comparatively recent colonisers could be at risk in the not too distant future. For example there is a trend towards re-establishing "native" woodland or habitat at the expense of conifer plantations. Whilst this is generally to be commended, there are many conifer associates which have been resident in this country for decades (or longer) and could now be considered part of the natural heritage. This is surely a question of balance of land use and management.

The British countryside is the result of man's management of the land over hundreds of years, though it is perhaps the rate of change in recent decades which has been most damaging. A landscape approach is needed for the management of our countryside, aimed at ensuring that there is appropriately managed habitat to support our biodiversity and that this habitat is not fragmented but linked up. Climate change is still likely to play its part, but with a linked-up landscape it is possible that the effects will be reduced.

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Appendix 1: Adventive or immigrant Lepidoptera species that have become established in Britain from 1900 to 1999

Note: Appendices 1 and 2 do not consider species in the Channel Islands or Ireland.

Species	Probable year of first record as a resident, where known	Site first recorded (Vice-county)	Foodplant(s)
Crocidosema plebejana Zeller	1900	Street (**3**)	Tree Mallow *Lavatera arborea*
Cacoecimorpha pronubana (Hübner)	1905	Bognor (**13**)	Polyphagous
Tachystola acroxantha (Meyrick)	1908	Ottery St Mary (**3**)	Leaf-litter
Clavigesta purdeyi (Durrant)	1911	Folkestone (**15**)	Pine *Pinus*
Blastobasis lignea Walsingham	1917	Grange and Witherslack (**69**)	Yew *Taxus*, Juniper *Juniperus* spp., fresh and decaying leaves etc.
Grapholita lobarzewskii (Nowicki)	1922	Sittingbourne (**15**)	*Prunus* spp. and Apple *Malus* spp.
Phyllonorycter geniculella (Ragonot)	1924	Tubney (**22**)	Sycamore *Acer pseudoplatanus*
Stigmella suberivora (Stainton)	1927	Ventnor (**10**)	Evergreen Oak *Quercus ilex*
Carpatolechia alburnella (Zeller)	1927	Strensall (**62**)	Birch *Betula* spp.
Udea fulvalis (Hübner)	1927	Bournemouth (**9** or **11**)	Labiatae, including Catmint *Nepeta cataria*, Black Horehound *Ballota nigra* and Meadow Clary *Salvia pratensis*
Phyllonorycter strigulatella (Lienig & Zeller)	1928	Cothill (**22**)	Grey Alder *Alnus incana*
Ostrinia nubilalis (Hübner)	1930s	Counties bordering the Thames Estuary	Mugwort *Artemisia vulgaris*
L-album Wainscot *Mythimna l-album* (Linnaeus)	1930s	Coasts of Cornwall and Devon	Probably various grasses Graminaceae
Cydia conicolana (Heylaerts)	1930	New Forest (**11**)	Scot's Pine *Pinus sylvestris*, Austrian Pine *P. nigra* ssp.
Ectoedemia decentella (Herrich-Schäffer)	1931	Eastbourne (**14**)	Sycamore *Acer pseudoplatanus*
Yarrow Pug *Eupithecia millefoliata* Rössler	1933	Hamstreet (**15**)	Yarrow *Achillea millefolium*
Clifden Nonpareil *Catocala fraxini* (Linnaeus)	1935(-1964)	near Hamstreet (**15**)	Aspen *Populus tremula*
Epiphyas postvittana (Walker)	1936	Newquay (**1**)	Polyphagous
Caloptilia azaleella (Brants)	1936	Bournemouth (**9** or **11**)	Azalea *Rhododendron simsii*, *R. indicum* etc.
Ethmia terminella Fletcher	1937	Dungeness (**15**)	Viper's Bugloss *Echium vulgare*
Rest Harrow *Aplasta ononaria* (Fuessly)	1937	Folkestone (**15**)	Common Restharrow *Ononis repens*
Psychoides filicivora (Meyrick)	1940	Bournemouth (**9**)	Various ferns including Male Fern *Dryopteris filis-mas*
Lunar Double-stripe *Minucia lunaris* ([Denis & Schiffermüller])	1942(-1958)	Orlestone arca (**15**)	Oak *Quercus*

Species	Probable year of first record as a resident, where known	Site first recorded (Vice-county)	Foodplant(s)
Leek Moth *Acrolepiopsis assectella* (Zeller)	1943	Bexhill district (**14**)	Onion, leek or garlic *Allium* spp.
Pammene aurita Razowski	1943	Dover (**15**)	Sycamore *Acer pseudoplatanus*
Cydia milleniana (Adaczewski)	1944	Thetford district & East Harling (**28**)	Larch *Larix*
Lozotaeniodes formosanus (Geyer)	1945	North-west Surrey (**17**)	Scots Pine *Pinus sylvestris*
Blair's Wainscot *Sedina buettneri* (Hering)	1945 (-1952, 1996-)	Freshwater (**10**)	Lesser Pond-sedge *Carex acutiformis*
Blastobasis decolorella (Wollaston)	1946	Herne Hill (**16**)	Fallen and decaying leaves, dead insects etc.
Black V Moth *Arctornis l-nigrum* Müller	1947(-1960)	Bradwell-on-Sea (**18**)	Probably on a range of deciduous trees
Ectoedemia turbidella (Zeller)	1948	Stanmore Common (**21**)	Grey Poplar *Populus canescens*
Varied Coronet *Hadena compta* ([Denis & Schiffermüller])	1948	Dover (**15**)	Sweet William *Dianthus barbatus*
Adoxophyes orana (Fischer von Röslerstamm)	1950	Teynham (**15**)	Polyphagous, including leaves and fruit of Apple *Malus*, Pear *Pyrus* etc.
Sussex Emerald *Thalera fimbrialis* (Scopoli)	1950	Dungeness (**15**)	Wild Carrot *Daucus carota*, Ragwort *Senecio jacobaea*, Hoary Ragwort *S. erucifolius*
White-banded Carpet *Spargania luctuata* ([Denis & Schiffermüller])	1950	Hamstreet (**15**) and Uckfield (**14**)	Rosebay Willowherb *Chamerion angustifolium*
Ptycholomoides aeriferanus (Herrich-Schäffer)	1951	Westwell (**15**)	European Larch *Larix decidua*
Phlyctaenia perlucidalis (Hübner)	1951	Woodwalton Fen (**31**)	Thistle *Cirsium* spp.
Toadflax Brocade *Calophasia lunula* (Hufnagel)	1951	Dungeness (**15**)	Toadflax *Linaria* spp.
Blair's Shoulder Knot *Lithophane leautieri* (Boisduval)	1951	Freshwater (**10**)	Monterey Cypress *Cupressus macrocarpa* and other Cupressaceae
Marsh Mallow Moth (or Giant Ear) *Hydraecia osseola* (Staudinger)	1952	Romney Marsh (**14**)	Marsh Mallow *Althaea officinalis*
Coleotechnites piceaella (Kearfott)	1952	Pinner (**21**)	Norway Spruce *Picea abies*
Balsam Carpet *Xanthorhoe biriviata* (Borkhausen)	1955	Dedham Lock (**21**)	Orange Balsam *Impatiens capensis*
Ancylosis oblitella (Zeller)	ca. 1956	Thames estuary	Goosefoot *Chenopodium* spp.
Stigmella zelleriella (Snellen)	1957	Sandwich (**15**)	Creeping Willow *Salix repens*
Stigmella speciosa (Frey)	1957 [1914?]	Ockham (**17**)	Sycamore *Acer pseudoplatanus*

Species	Probable year of first record as a resident, where known	Site first recorded (Vice-county)	Foodplant(s)
Cypress Pug *Eupithecia phoeniceata* (Rambur)	1959	Lamorna Cove (**1**)	Monterey Cypress *Cupressus macrocarpa* and othe Cupressaceae
Phyllonorycter platanoidella (Joannis)	1962	Denbies (**17**)	Norway Maple *Acer platanoides*
Argolamprotes micella ([Denis & Schiffermüller])	1963	Ide (**3**)	*Rubus*
Monochroa horuigi (Staudinger)	1963	Buckingham Palace (**21**)	Knotgrass *Polygonum* spp.
Acleris abietana (Hübner)	1965	Aberfoyle (**87**)	Giant Fir *Abies grandis*
Cydia pactolana (Zeller)	1965	Alice Holt Forest (**12**)	Norway Spruce *Picea abies* and Larch *Larix*
Shaded Fan-foot *Herminia tarsicrinalis* (Knoch)	1965	Near Thorpeness (**25**)	Withered leaves
Stenoptilia millieridactyla (Bruand)	1969	Chesterfield (**57**)	Saxifrage *Saxifraga* spp.
Caloptilia rufipennella (Hübner)	1970	Chippenham Fen (**29**)	Sycamore *Acer pseudoplatanus*
Cydia medicaginis (Kuznetsov)	1970	Southampton (**11**)	Medick *Medicago* spp.
Monochroa moyses Uffen	1971	Mucking (**18**)	Sea Club-rush *Bolboschoenus maritimus*
Athrips rancidella (Herrich-Schäffer)	1971	West Wickham (**16**)	Cotoneaster *Cotoneaster horizontalis*
Ectoedemia erythrogenella (Joannis)	1973	Portland (**9**)	Bramble *Rubus fruticosus*
Coleophora fuscicornis Zeller	1973	Fingringhoe Wick (**19**)	Smooth Tare *Vicia tetrasperma*
Lampronia flavimitrella (Hübner)	1974	Martyr Worthy (**12**)	**Rubus**
Phyllocnisits xenia Hering	1974	near Dover (**15**)	Grey Poplar *Populus canescens*
Ectoedemia sericopeza (Zeller)	1975	Horseheath (**29**)	Norway Maple *Acer platanoides*
Tinagma balteolella (Fischer von Röslerstamm)	1975	East Kent (**15**)	Viper's Bugloss *Echium vulgare*
Cydia illutana (Herrich-Schäffer)	1975	Southsea (**11**)	Norway Spruce *Picea abies*, Silver Fir *Abies alba* and European Larch *Larix decidua*
Bisigna procerella ([Denis & Schiffermüller])	1976	Orlestone Forest (**15**)	Possibly on lichens
Coleophora linosyridella Fuchs	1978	Shellness (**15**)	Sea Aster *Aster tripolium*
Scarce Chocolate-tip *Clostera anachoreta* ([Denis & Schiffermüller])	1979	Dungeness (**15**)	*Salix* spp. and *Populus* spp.
Dioryctria schuetzeella Fuchs	1980	Orlestone Forest (**15**)	Norway Spruce *Picea abies*
Coleophora aestuariella Bradley	1981	Harty (**15**)	Sea Blite *Suaeda maritima*
Feathered Beauty *Peribatodes secundaria* (Esper)	1981	Hamstreet (**15**)	Norway Spruce *Picea abies* and probably other conifers
Emmetia heinemanni (Wocke)	1984	Thornden Wood (**15**)	*Rubus*

Species	Probable year of first record as a resident, where known	Site first recorded (Vice-county)	Foodplant(s)
Monochroa niphognatha Gozmány	1984	Stodmarsh (**15**)	?Amphibious Bistort *Persicaria amphibia*
Cypress Carpet *Thera cupressata* (Geyer)	1984	West Sussex (**13**)	Monterey Cypress *Cupressus macrocarpa* and Cypress *Cupressocyparis* x *leylandii*
Gelechia senticetella (Staudinger)	1988	Grays (**18**)	Juniper *Juniperus* spp., Cypresses *Cupressocyparis* and *Chamaecyparis*
Phyllonorycter leucographella (Zeller)	1989	Wickford (**18**)	Firethorn *Pyracantha*
Phyllonorycter platani (Staudinger)	1990	South Kensington (**21**)	London Plane *Platanus* x *hispanica*
Channel Islands Pug *Eupithecia ultimaria* Boisduval	1990	Walberton (**13**)	Tamarisk *Tamarix gallica*
Bloxworth Snout *Hypena obsitalis* (Hübner)	1990	Torquay (**3**)	Pellitory *Parietaria judaica*
Sciota adelphella (Fischer von Röslerstamm)	1992	Dungeness & Greatstone (**15**)	White Willow *Salix alba*
Cochylis molliculana Zeller	1993	Portland (**9**)	Bristly Oxtongue *Picris echioides*
Evergestis limbata (Linnaeus)	1993	Chale Green (**10**)	Garlic Mustard *Alliaria petiolata* & Hedge Mustard *Sisymbrium officinale*
Dioryctria sylvestrella (Ratzeburg)	1995	Reindene Wood (**15**)	Scot's Pine *Pinus sylvestris* and other *Pinus* spp., White Spruce *Picea glauca*
Blair's Wainscot *Sedina buettneri* (Hering)	1996	(**9**)	Lesser Pond-sedge *Carex acutiformis*
Argyresthia cupressella Walsingham	1997	Ufford (**25**)	Cypresses *Cupressocyparis leylandii* and *Chamaecyparis lawsoniana*, Juniper *Juniperus scopulorum*
Argyresthia trifasciata Staudinger	1997	Cheadle (**58**)	Juniper *Juniperus* spp., Cedar *Thuja* spp. and Cypresses *Chamaecyparis* spp. or *Cupressocyparis leylandii*
Vitula biviella (Zeller)	1997	Lydd (**15**)	Pine *Pinus*
Small Ranunculus *Hecatera dysodea* ([Denis & Schiffermüller])	1997	Gravesend (**16**)	Wild and cultivated Lettuce *Lactuca* spp.
Eucosma metzneriana (Treitschke)	1998	Wilmington (**16**)*	Wormwood *Artemisia absinthium* and Mugwort *A. vulgare*
Haimbachia cicatricella (Hübner)	1999	Dungeness (**15**)**	Common Club-rush *Scirpus lacustris*

Notes:

* This species has been noted as the occasional singleton prior to this date, but is not thought to have become established in Britain until 1998.

** This species may not be established, but it was also noted in the general area in 2000 and 2001.

Appendix 2: Lepidoptera species considered extinct (or with no recent record) from 1900 to 1999

Note: Four species, indicated by a dagger (†), have very few records in this country and their status is open to question.

Species	Date of last record	Site of last record	Foodplant(s)
Lyonetia prunifoliella (Hübner)	ca1900	Stony Stratford (**24**) and/or Whittlebury Forest (**32**) and/or Boughton (**37**)	Various rosaceous shrubs and trees, including Blackthorn *Prunus spinosa* and Hawthorn *Crataegus* spp.
Archips betulana (Hübner)	ca1900	near King's Lynn (**28**)	Bog Myrtle *Myrica gale*
Cosmopterix schmidiella Frey	1901	Shalbourne (**8**)	Bush vetch *Vicia sepium*
Mazarine Blue *Polyommatus semiargus* (Rottemburg)	1903	nr. Epworth (**54**)	possibly Red Clover *Trifolium pratense*
Mesophleps silacella (Hübner)	1906	Moulsecoomb (**14**)	Common Rock-rose *Helianthemum nummularium*
Gypsy Moth *Lymantria dispar* (Linnaeus)	1907	Wennington Wood (**31**)	Wide variety of wild and cultivated trees. there is a suggestion that the British race was biotypically distinct being associated with Bog Myrtle *Myrica gale* and Creeping Willow *Salix repens*
Gypsonoma nitidulana (Lienig & Zeller)	1908	Aviemore (**95**)	Aspen *Populus tremula*
†*Gnorimoschema streliciella* (Herrich-Schäffer)	*1909*	*Aviemore (95)*	*?Wild Thyme* Thymus polytrichus
Stigmella torminalis (Wood)	ca1910	Stoke Edith Wood (**36**)	Wild Service Tree *Sorbus terminalis*
Scarce Dagger *Acronicta auricoma* ([Denis & Schiffermüller])	1912	Abbots Wood (**14**)	Oak Quercus spp.
Pristerognatha penthinana (Guenée)	1914	Lake Windermere (**69**)	Touch-me-not *Impatiens noli-tangere*
Frosted Yellow *Isturgia limbaria* (Fabricius)	1914	East Anglia	Broom *Cytisus scoparius*
Orache *Trachea atriplicis* (Linnaeus)	ca1915	near Stowmarket (**25** or **26**)	Orache *Atriplex* spp., Goosefoot *Chenopodium* spp., Pale Persicaria *Polygonum lapathifolium*
Flame Brocade *Trigonophora flammea* (Esper)	ca1919	Chailey (**14**)	Possibly low-growing plants
Union Rustic *Eremobina pabulatricula* (Brahm)	1919	border of Lincolnshire and Nottinghamshire	Woodland grasses
Phtheochroa schreibersiana (Frölich)	1920	Wicken Fen (**29**)	Elm *Ulmus* spp., Black Poplar *Populus nigra* and Bird Cherry *Prunus padus*
Depressaria discipunctella Herrich-Schäffer	1924	Tubney (**22**)	Hogweed *Heracleum sphondylium*, Wild Parsnip *Pastinaca sativa* andWild Angelica *Angelica sylvestris*
Dusky Clearwing *Parathrene tabaniformis* (Rottemburg)	1924	Tubney (22)	Poplar *Populus* spp.

Species	Date of last record	Site of last record	Foodplant(s)
Black-veined White *Aporia crataegi* (Linnaeus)	ca1925	(**15** & **37**)	Blackthorn *Prunus spinosa*, Plum *P. domestica*, Hawthorn *Crataegus* spp. and Apple *Malus* spp.
Psamathocrita osseella (Stainton)	1926	Cranham (**33**)	Unknown
†*Scrobipalpula diffluella* (Frey)	*1926*	*Erith Marshes (16)*	*?Blue Fleabane* Erigeron acer
New Forest Burnet *Zygaena viciae ytenensis* Briggs	1927	New Forest (**11**)	Meadow Vetchling *Lathyrus pratensis* and Common Bird's foot Trefoil *Lotus corniculatus*
Small Ranunculus *Hecatera dysodea* ([Denis & Schiffermüller])	Late 1920s	Whittlesey (**29**)	Prickly Lettuce *Lactuca serriola*, Great Lettuce *L. virosa*, Garden lettuce *L. sativa*
Coleophora antennariella Herrich-Schäffer	ca1930	Nettlebed (**23**)	Hairy Wood-rush *Luzula pilosa*
Isle of Wight Wave *Idaea humiliata* (Hufnagel)	1931	near Freshwater (**10**)	Probably low-growing plants
†*Scythris fuscoaenea* (Haworth)	*1932*	*Monks Soham (25)*	*Rock-rose* Helianthemum *spp.*
Aethes margarotana (Duponchel)	1932 (bred 1933)	St Osyth (**18**)	Sea Holly *Eryngium maritimum*
Red-headed Chestnut *Conistra erythrocephala* ([Denis & Schiffermüller])	1932	Plashett Wood, near Lewes and Og's Wood near Eastbourne (**14**)	Possibly on young leaves of Oak *Quercus* spp. and Elm *Ulmus* spp. then low-rowing plants (Skinner, 1998)
Dichomeris derasella ([Denis & Schiffermüller])	1933	Chiddingfold (**17**)	Blackthorn *Prunus spinosa*
Marsh Dagger *Acronicta strigosa* ([Denis & Schiffermüller])	1933	(**29** and/or **31**)	Hawthorn *Crataegus* spp. and Blackthorn *Prunus spinosa*
Tenaga nigripunctella (Haworth)	1934	Dymchurch (**15**)	Detritus?
Pyrausta sanguinalis (Linnaeus)	1935	Wallasey sandhills (**58**)	Thyme *Thymus polytrichus*
Gibberifera simplana (Fischer von Röslerstamm)	1938	Hadleigh (**18**)	Aspen *Populus tremula*
†*Stenoptinea cyaneimarmorella* (Milliére)	1944	Bexley (16)	Unknown, but possible rotten wood or lichens
Leucoptera sinuella (Reutti)	1950s	Aviemore (**95**)	Aspen *Populus tremula*
Blair's Wainscot *Sedina buettneri* (Hering)	1952	Freshwater Marsh (**10**)	Lesser Pond-sedge *Carex acutiformis*
Large Tortoiseshell *Nymphalis polychloros* (Linnaeus)	ca1953	nr. Ipswich (**25**)	Elm *Ulmus* spp., Sallow and Willow *Salix* spp.
Augasma aeratella (Zeller)	1956	Wimborne (**9**)	Knotgrass *Polygonum aviculare*
Lunar Double Stripe *Minucia lunaris* ([Denis & Schiffermüller])	1958	Orlestone area (**15**)	Oak *Quercus* spp.
Conformist *Lithophane furcifera suffusa* Tutt	1959	Cardiff (**41**)	Possibly Alder *Alnus glutinosa*
Eurhodope cirrigerella (Zincken)	1960	Itchen Valley (**12**)	Field Scabious *Knautia arvensis* and Greater Knapweed *Centaurea scabiosa*
Black V Moth *Arctornis l-nigrum* Müller	1960	Bradwell-on-Sea (**18**)	Probably on a range of deciduous trees

Species	Date of last record	Site of last record	Foodplant(s)
Spotted Sulphur *Emmelia trabealis* (Scopoli)	1960	Mildenhall (**26**)	Field Bindweed *Convolvulus arvensis*
Stenoptilia pneumonanthes (Büttner)	1961	Parley Heath (**9**)	Marsh Gentian *Gentiana pneumonanthes*
Lewes Wave *Scopula immorata* (Linnaeus)	1961	Vert Wood (**14**)	Probably low-growing plants Skinner (1998)
Choristoneura lafauryana (Ragonot)	1962	near King'Lynn (**28**)	Bog Myrtle *Myrica gale*
Transparent Burnet *Zygaena purpuralis* ssp. *segontii* Tremewan	1962	Abersoch (**49**)	Wild Thyme *Thymus praecox*
Feathered Ear *Pachetra sagittigera britannica* Turner	1963	Wye Crown (**15**)	Various grasses
Oxyptilus pilosellae (Zeller)	1964	Beaconsfield (**24**)	Mouse-ear Hawkweed *Hieracium pilosella*
Clifden Nonpareil *Catocala fraxini* (Linnaeus)	1964	near Hamstreet (**15**)	Aspen *Populus tremula*
Small Lappet *Phyllodesma ilicifolia* (Linnaeus)	1965	Weston-super-Mare (**6**)	Bilberry *Vaccinium myrtillus*
Borkhausenia minutella (Linnaeus)	1966*	Chiddingfold (**17**)	Seeds and dry vegetable matter
Viper's Bugloss *Hadena irregularis* (Hufnagel)	1968	Breckland, East Anglia	Spanish Catchfly *Silene otites*
Margaritia sticticalis (Linnaeus)	as late as 1970	Eriswell (**26**)	Mugwort *Artemisia vulgaris*
Nothris verbascella (Hübner)	1971	Snettisham Quarry (**28**)	Hoary Mullein *Verbascum pulverulentum*
Bond's Wainscot *Chortodes morrisii bondii* (Knaggs)	1973	Folkestone (**15**)	Tall fescue *Festuca arundinacea*
Euhyponomeuta stannella (Thunberg)	1976	Dovedale (**39**)	Orpine *Sedum telephium*
Cydia leguminana (Lienig & Zeller)	1976	Wicken Fen (**29**)	Decaying bark of Elm *Ulmus* spp.
Lesser Belle *Colobochyla salicalis* ([Denis & Schiffermüller])	1977	near Hamstreet (**15**)	Aspen *Populus tremula*, larvae require young growth of aspen
Hypercallia citrinalis (Scopoli)	1979	Trottiscliffe (**16**)	Milkwort
Large Blue *Maculinea arion eutyphron* (Fruhstorfer)	1979	south-east Dartmoor (**3**)	Wild Thyme *Thymus praecox* and *Myrmica sabuleti* ants (early stages)
Cudweed *Cucullia gnaphalii occidentalis* Boursin	1979	West of Peasmarsh (**14**)	Goldenrod *Solidago virgaurea*
Coleophora vibicigerella Zeller	1980	Isle of Sheppey (**15**)	Sea Wormwood *Artemisia maritima*
Coleophora albella (Thunberg)	1985	Wickwar Woods (**34**)	Ragged Robin *Lychnis flos-cuculi*
Syncopacma vinella (Bankes)	1990	Ditchling Common (**14**)	Dyer's Greenweed *Genista tinctoria* and Crown-vetch *Coronilla varia*
Essex Emerald *Thetidia smaragdaria maritima* (Prout)	ca1991	(**15**)	Sea Wormwood *Artemisia maritima*

* A possible example of this species was found in 2002 in Kent. Confirmation is awaited (D.J.L. Agassiz pers. comm.)